

Attorney Docket No.: 071469-0308546
Client Reference: RAJ-010

IN THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A method of forming a metal layer on a substrate, the method comprising:
forming a plasma in a process chamber containing a substrate;
pre-treating the substrate by exposing the substrate to excited species in ~~a plasma~~ the plasma;
exposing the pre-treated substrate to a process gas containing a metal-carbonyl precursor in the absence of a plasma; and
forming a metal layer on the pre-treated substrate by decomposition of the metal-carbonyl precursor in a chemical vapor deposition process.
2. (Original) The method according to claim 1, wherein the substrate comprises a semiconductor substrate, a LCD substrate, or a glass substrate.
3. (Original) The method according to claim 1, wherein the pre-treating comprises:
creating a plasma from a pre-treatment gas including H₂, N₂, NH₃, He, Ne, Ar, Kr, or Xe or a combination of two or more thereof; and
exposing the substrate to excited species in the plasma.
4. (Original) The method according to claim 3, wherein the creating further comprises energizing an inductive coil and/or a substrate holder.
5. (Original) The processing system according to claim 4, wherein the energizing comprises applying RF power between about 500 W and about 3,000 W at a frequency between about 0.1 MHz and about 100 MHz to the inductive coil and/or applying

Attorney Docket No.: 071469-0308546

Client Reference: RAJ-010

RF power between about 0 W and about 2,000 W at a frequency between about 0.1 MHz and about 100 MHz to the substrate holder.

6. (Original) The method according to claim 3, wherein the creating further comprises flowing the pre-treatment gas at a gas flow rate between about 1 sccm and about 1,000 sccm.

7. (Original) The method according to claim 3, wherein the creating further comprises providing a pre-treatment gas pressure between about 0.3 mTorr and about 3,000 mTorr.

8. (Original) The method according to claim 1, wherein the pre-treating further comprises providing a substrate temperature between about -30°C and about 500°C .

9. (Original) The method according to claim 1, wherein the pre-treating comprises exposing the substrate to excited species in a plasma for between about 5 seconds and about 300 seconds.

10. (Original) The method according to claim 1, wherein the process gas comprises $\text{W}(\text{CO})_6$, $\text{Ni}(\text{CO})_4$, $\text{Mo}(\text{CO})_6$, $\text{Co}_2(\text{CO})_8$, $\text{Rh}_4(\text{CO})_{12}$, $\text{Re}_2(\text{CO})_{10}$, $\text{Cr}(\text{CO})_6$, or $\text{Ru}_3(\text{CO})_{12}$ or a combination of two or more thereof.

11. (Original) The method according to claim 1, wherein the process gas comprises a metal-carbonyl precursor and H_2 , N_2 , He, Ne, Ar, Kr, or Xe, or a combination of two or more thereof.

12. (Original) The method according to claim 1, wherein the exposing includes flowing the process gas at a gas flow rate between about 10 sccm and about 3,000 sccm.

Attorney Docket No.: 071469-0308546
Client Reference: RAJ-010

13. (Original) The method according to claim 1, wherein the exposing includes flowing the metal-carbonyl precursor at a gas flow rate between about 0.1 sccm and about 200 sccm.
14. (Original) The method according to claim 1, wherein the forming comprises forming a layer containing W, Ni, Mo, Co, Rh, Re, Cr, or Ru, or a combination of two or more thereof.
15. (Original) The method according to claim 1, wherein the forming further comprises heating the substrate to between about 250° C and about 600° C.
16. (Original) The method according to claim 1, wherein the forming further comprises heating the substrate to about 400° C.
17. (Original) The method according to claim 1, wherein the forming further comprises providing a process gas pressure between about 10 mTorr and about 5 Torr.
18. (Currently Amended) The method according to claim 1, wherein the chemical vapor deposition process comprises thermal chemical vapor deposition, atomic layer chemical vapor deposition, ~~or plasma-enhanced chemical vapor deposition~~ or any a combination thereof.
19. (Original) The method according to claim 1, wherein the pre-treating, exposing, and forming are carried out in at least one processing system.
20. (Currently Amended) A method of forming a tungsten layer on a substrate, the method comprising:
forming a plasma in a process chamber containing a substrate;
pre-treating the substrate by exposing the substrate to excited species ~~in a~~ in the plasma, wherein the plasma is formed from a pre-treatment gas containing H₂, N₂, NH₃, He, Ne, Ar, Kr, or Xe or a combination of two or more thereof;

Attorney Docket No.: 071469-0308546

Client Reference: RAJ-010

exposing the pre-treated substrate to a process gas containing a $W(CO)_6$ precursor in the absence of a plasma; and

forming a tungsten layer on the pre-treated substrate by thermal decomposition of the $W(CO)_6$ precursor in a thermal chemical vapor deposition process.

21. (Withdrawn) A processing tool for forming a metal layer, comprising:
a transfer system configured for transferring a substrate within the processing tool;
at least one processing system configured for pre-treating a substrate by exposing the substrate to excited species in a plasma and exposing the pre-treated substrate to a process gas containing a metal-carbonyl precursor to form a metal layer on the pre-treated substrate in a chemical vapor deposition process; and
a controller configured to control the processing tool.

22. (Withdrawn) The processing tool according to claim 21, wherein the substrate comprises a semiconductor substrate, a LCD substrate, or a glass substrate.

23. (Withdrawn) The processing tool according to claim 21, wherein the at least one processing system contains a plasma created from a pre-treatment gas containing H_2 , N_2 , NH_3 , He, Ne, Ar, Kr, or Xe or a combination of two or more thereof, the substrate being exposed to excited species in the plasma.

24. (Withdrawn) The processing tool according to claim 23, wherein the at least one processing system includes a plasma source configured to create the plasma.

25. (Withdrawn) The processing tool according to claim 24 wherein the plasma source includes an inductive coil and/or a substrate holder.

26. (Withdrawn) The processing tool according to claim 25, wherein the plasma source is configured for applying RF power between about 500 W and about 3,000 W at a frequency between about 0.1 MHz and about 100 MHz to the inductive coil and/or applying

Attorney Docket No.: 071469-0308546
Client Reference: RAJ-010

RF power between about 0 W and about 2,000 W at a frequency between about 0.1 MHz and about 100 MHz to the substrate holder.

27. (Withdrawn) The processing tool according to claim 23, wherein the at least one processing system comprises a gas delivery system configured to flow the pre-treatment gas at a gas flow rate between about 1 sccm and about 1,000 sccm.

28. (Withdrawn) The processing tool according to claim 23, wherein the at least one processing system provides a pre-treatment gas pressure between about 0.3 mTorr and about 3,000 mTorr.

29. (Withdrawn) The processing tool according to claim 21, wherein the at least one processing system provides a substrate pre-treating temperature between about -30°C and about 500°C .

30. (Withdrawn) The processing tool according to claim 21, wherein the at least one processing system exposes the substrate to excited species in a plasma for between about 5 seconds and about 300 seconds.

31. (Withdrawn) The processing tool according to claim 21, wherein the process gas comprises $\text{W}(\text{CO})_6$, $\text{Ni}(\text{CO})_4$, $\text{Mo}(\text{CO})_6$, $\text{Co}_2(\text{CO})_8$, $\text{Rh}_4(\text{CO})_{12}$, $\text{Re}_2(\text{CO})_{10}$, $\text{Cr}(\text{CO})_6$, or $\text{Ru}_3(\text{CO})_{12}$ or a combination of two or more thereof.

32. (Withdrawn) The processing tool according to claim 21, wherein the process gas comprises a metal-carbonyl precursor and H_2 , He, Ne, Ar, Kr, or Xe or a combination of two or more thereof.

33. (Withdrawn) The processing tool according to claim 21, wherein the at least one processing system comprises a gas delivery system which causes the process gas to flow at a gas flow rate between about 10 sccm and about 3,000 sccm.

Attorney Docket No.: 071469-0308546
Client Reference: RAJ-010

34. (Withdrawn) The processing tool according to claim 21, wherein the at least one processing system comprises a gas delivery system which causes the metal-carbonyl precursor to flow at a gas flow rate between about 0.1 sccm and about 200 sccm.

35. (Withdrawn) The processing tool according to claim 21, wherein the at least one processing system forms the metal layer containing W, Ni, Mo, Co, Rh, Re, Cr, or Ru or a combination of two or more thereof.

36. (Withdrawn) The processing tool according to claim 21, wherein the at least one processing system heats the substrate to between about 250° C and about 600° C while forming the metal layer.

37. (Withdrawn) The processing tool according to claim 21, wherein the at least one processing system heats the substrate to about 400° C while forming the metal layer.

38. (Withdrawn) The processing tool according to claim 21, wherein at least one processing system provides a process gas pressure between about 10 mTorr and about 5 Torr.

39. (Withdrawn) The processing tool according to claim 21, wherein the chemical vapor deposition process comprises thermal chemical vapor deposition, atomic layer chemical vapor deposition, or plasma-enhanced chemical vapor deposition or any combination thereof.

40. (Withdrawn) The processing tool according to claim 21, wherein the at least one processing system includes only one processing system.

41. (Withdrawn) The processing tool according to claim 21, wherein the at least one processing system includes at least two processing systems.

Attorney Docket No.: 071469-0308546

Client Reference: RAJ-010

42. (Withdrawn) The processing tool according to claim 24, wherein the plasma source comprises a remote plasma source, an inductive coil, a plate electrode, an antenna, an ECR source, a Helicon wave source, or a surface wave source or any combination of two or more thereof.

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☒ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.